CLAIMS

1. A wireless packet communication method for transmitting from a transmit-side STA a wireless packet by using a wireless channel determined to be idle by both of physical carrier sense and virtual carrier sense when multiple wireless channels are provided between the transmit-side STA and one or more receive-side STAs, the physical carrier sense determining a wireless channel to be busy or idle from received power, the virtual carrier sense determining a wireless channel to be busy during a set transmission inhibition time, the method characterized by comprising

setting transmission inhibition time to a paired wireless channel by said transmit-side STA, the paired wireless channel being a wireless channel affected by leakage from a transmitting wireless channel, the transmission inhibition time being used in the virtual carrier sense.

2. A wireless packet communication method for simultaneously transmitting from a transmit-side STA a plurality of wireless packets by using multiple wireless channels determined to be idle by both of physical carrier sense and virtual carrier sense when multiple wireless channels are provided between the transmit-side STA and one or more receive-side STAs, the physical carrier sense determining a wireless channel to be busy or idle from received power, the virtual carrier sense determining a wireless channel to be busy during a set transmission inhibition time, the method characterized by comprising

setting, by said transmit-side STA, time (Tmax + Ts) as transmission inhibition time to a paired wireless channel other than a wireless channel which requires longest transmission time Tmax among wireless channels used for simultaneous transmission, the transmission inhibition time used in the virtual carrier sense, the time (Tmax + Ts) obtained by adding predetermined time Ts to the longest transmission time Tmax.

3. The wireless packet communication method according to claim 2, characterized by

further comprising

setting, by said transmit-side STA, the time (Tmax + Ts) to the paired wireless channel as a new transmission inhibition time when an existing set transmission inhibition time for said virtual carrier sense is smaller than the time (Tmax + Ts).

4. A wireless packet communication method for simultaneously transmitting from a transmit-side STA a plurality of wireless packets by using multiple wireless channels determined to be idle by both of physical carrier sense and virtual carrier sense when multiple wireless channels are provided between the transmit-side STA and one or more receive-side STAs, the physical carrier sense determining a wireless channel to be busy or idle from received power, the virtual carrier sense determining a wireless channel to be busy during a set transmission inhibition time, the method characterized by comprising:

predetermining, by said transmit-side STA, combinations of wireless channels among the multiple wireless channels, the combinations of wireless channels having an effect on each other due to a leakage of transmitted power; and

setting, by said transmit-side STA, time (Ti + Ts) as transmission inhibition time to a paired wireless channel other than a wireless channel which requires longest transmission time Ti among respective combinations of wireless channels, the transmission inhibition time being used in the virtual carrier sense, the time (Ti + Ts) obtained by adding a predetermined time Ts to the longest transmission time Ti.

5. The wireless packet communication method according to claim 4, characterized by further comprising

setting, by said transmit-side STA, the time (Ti + Ts) to the paired wireless channel as a new transmission inhibition time when an existing set transmission inhibition time for said virtual carrier sense is smaller than the time (Ti + Ts).

6. The wireless packet communication method according to any one of claims 1 to 5,

characterized by further comprising

detecting, by said transmit-side STA, received power due to a leakage from a transmitting wireless channel in the paired wireless channel, and setting the transmission inhibition time to a paired wireless channel which has received power greater than or equal to a predetermined threshold value.

7. The wireless packet communication method according to any one of claims 1 to 6, characterized by further comprising

detecting, by said transmit-side STA, an error in a received signal in the paired wireless channel, and setting the transmission inhibition time to a paired wireless channel having the error detected.

8. The wireless packet communication method according to any one of claims 1 to 7, characterized by further comprising:

when receiving a wireless packet over the paired wireless channel at said transmit-side STA,

performing, by said transmit-side STA, an error detection to the received wireless packet:

when a wireless channel having normally received a wireless packet directed to an own STA has the set transmission inhibition time, canceling the transmission inhibition time by said transmit-side STA; and

when occupied time is set in a header of the received wireless packet, setting, by said transmit-side STA, a new transmission inhibition time in accordance with the occupied time.

9. The wireless packet communication method according to any one of claims 1 to 8, characterized by further comprising

when there is a wireless channel having the set transmission inhibition time at the

time of transmission data generation, transmitting, by said transmit-side STA, a wireless packet using said wireless channel determined to be idle after waiting until the transmission inhibition time elapses.

10. The wireless packet communication method according to any one of claims 1 to 8, characterized by further comprising:

when there are wireless channels having set transmission time at the time of transmission data generation,

transmitting, by said transmit-side STA, a wireless packet using said wireless channel determined to be idle after waiting until the transmission inhibition time elapses when the longest transmission inhibition time is smaller than a predetermined threshold value; or

transmitting, by said transmit-side STA, a wireless packet using said wireless channel determined to be idle without waiting until the transmission inhibition time elapses when the longest transmission inhibition time is greater than or equal to the predetermined threshold value.

11. The wireless packet communication method according to any one of claims 1 to 8, characterized by further comprising

when there is a wireless channel having the set transmission inhibition time at the time of transmission data generation, transmitting, by said transmit-side STA, a wireless packet using said wireless channel determined to be idle with a predetermined probability without waiting until the transmission inhibition time elapses.

12. The wireless packet communication method according to any one of claims 1 to 8, characterized by further comprising

when transmission data is generated, transmitting, by said transmit-side STA, a wireless packet using said wireless channel determined to be idle after waiting until all

wireless channels are determined to be idle by said physical carrier sense and said virtual carrier sense.

13. The wireless packet communication method according to any one of claims 1 to 8, characterized by further comprising:

when transmission data is generated,

transmitting, by said transmit-side STA, wireless packets using said wireless channels determined to be idle after waiting until all wireless channels are determined to be idle by said physical carrier sense and said virtual carrier sense; or

transmitting, by said transmit-side STA, wireless packets using said wireless channels determined to be idle without waiting until the transmission inhibition time elapses when the longest transmission inhibition time of the set transmission inhibition time of wireless channels is greater than or equal to a predetermined threshold value.

14. The wireless packet communication method according to claim 10 or 13, characterized by further comprising:

when there are wireless channels having the set transmission inhibition time,

transmitting, by said transmit-side STA, a wireless packet using said wireless channel determined to be idle after waiting until the transmission inhibition time elapses when there is a wireless channel having set transmission inhibition time smaller than a predetermined threshold value; or

transmitting, by said transmit-side STA, a wireless packet using said wireless channel determined to be idle without waiting until the transmission inhibition time elapses when no wireless channel has set transmission inhibition time smaller than the predetermined threshold value.

15. The wireless packet communication method according to claim 14, characterized by further comprising

said transmit-side STA's returning to determine whether there is a wireless channel having the set transmission inhibition time or whether all wireless channels are idle, after waiting until the transmission inhibition time elapses when there are wireless channels having the set transmission inhibition time and there is a wireless channel having set transmission inhibition time smaller than a predetermined threshold value.

16. The wireless packet communication method according to any one of claims 1 to 8, characterized by further comprising

when transmission data is generated, transmitting, by said transmit-side STA, a wireless packet using said wireless channel determined to be idle after waiting or without waiting with a predetermined probability until all wireless channels are determined to be idle by said physical carrier sense and said virtual carrier sense.

17. The wireless packet communication method according to any one of claims 1 to 8, characterized by further comprising:

when receiving a wireless packet having set transmission inhibition time, setting, by said receive-side STA, the transmission inhibition time to a wireless channel having received the wireless packet, and when normally receiving a wireless packet directed to an own STA, transmitting, by said receive-side STA, an ACK packet to said transmit-side STA, the ACK packet including the transmission inhibition time set in the paired wireless channel; and

when receiving a corresponding ACK packet within a predetermined period of time after having transmitted said wireless packet, updating, by said transmit-side STA, transmission inhibition time set for the paired wireless channel to transmission inhibition time of the paired wireless channel included in the ACK packet.

18. A wireless packet communication method for assigning, by a transmit-side STA, a plurality of wireless packets, respectively, to a plurality of sub-channels determined to be idle by both physical carrier sense and virtual carrier sense for simultaneous transmission,

when sub-channels to be multiplexed into one wireless channel are provided between a transmit-side STA and one or more receive-side STAs, the physical carrier sense in which said transmit-side STA determines each sub-channel to be busy or idle from received power, the virtual carrier sense in which said transmit-side STA determines each sub-channel to be busy during set transmission inhibition time, the method characterized by comprising

setting, by said transmit-side STA, time (Tmax + Ts) as transmission inhibition time to sub-channels other than a sub-channel which requires longest transmission/reception time Tmax among sub-channels used for simultaneous transmission, the time (Tmax + Ts) being obtained by adding a predetermined time Ts to the longest transmission/reception time Tmax, the transmission inhibition time being used in the virtual carrier sense.

19. The wireless packet communication method according to claim 18, characterized by further comprising

setting the time (Tmax + Ts) as a new transmission inhibition time by said transmit-side STA when an existing set transmission inhibition time for said virtual carrier sense is smaller than the time (Tmax + Ts).

20. A wireless packet communication apparatus provided with multiple wireless channels between a transmit-side STA and one or more receive-side STAs for transmitting from the transmit-side STA a wireless packet by using a wireless channel determined to be idle by both of a physical carrier sense unit and a virtual carrier sense unit, the physical carrier sense unit determining a wireless channel to be busy or idle from received power, the virtual carrier sense unit determining a wireless channel to be busy during set transmission inhibition time, the apparatus characterized by comprising

a virtual carrier sense unit of said transmit-side STA setting transmission inhibition time to a paired wireless channel, the transmission inhibition time being used in the virtual carrier sense, the paired wireless channel being a wireless channel affected by leakage from

a transmitting wireless channel.

21. A wireless packet communication apparatus provided with multiple wireless channels between a transmit-side STA and one or more receive-side STAs for simultaneously transmitting from the transmit-side STA a plurality of wireless packets by using multiple wireless channels determined to be idle by both of a physical carrier sense unit and a virtual carrier sense unit, the physical carrier sense unit determining a wireless channel to be busy or idle from received power, the virtual carrier sense unit determining a wireless channel to be busy during set transmission inhibition time, the apparatus characterized by comprising

a virtual carrier sense unit of said transmit-side STA setting time (Tmax + Ts) as the transmission inhibition time to a paired wireless channel other than a wireless channel which requires longest transmission time Tmax among wireless channels used for simultaneous transmission, the time (Tmax + Ts) obtained by adding the predetermined time Ts to the longest transmission Tmax.

22. The wireless packet communication apparatus according to claim 21, characterized in that

when an existing set transmission inhibition time is smaller than the time (Tmax + Ts), the virtual carrier sense unit of said transmit-side STA sets the time (Tmax + Ts) to the paired wireless channel as a new transmission inhibition time.

23. A wireless packet communication apparatus provided with multiple wireless channels between a transmit-side STA and one or more receive-side STAs for simultaneously transmitting from the transmit-side STA a plurality of wireless packets by using multiple wireless channels determined to be idle by both of a physical carrier sense unit and a virtual carrier sense unit, the physical carrier sense unit determining a wireless channel to be busy or idle from received power, the virtual carrier sense unit determining a

wireless channel to be busy during set transmission inhibition time, the apparatus characterized by comprising

a virtual carrier sense unit of said transmit-side STA predetermining combinations of wireless channels which have an effect of leakage of transmitted power on each other among multiple wireless channels, and setting time (Ti + Ts) as the transmission inhibition time to a paired wireless channel other than a wireless channel which requires longest transmission time Ti among respective combinations of wireless channels, the time (Ti + Ts) obtained by adding a predetermined time Ts to the longest transmission time Ti.

24. The wireless packet communication apparatus according to claim 23, characterized in that

when an existing set transmission inhibition time is smaller than the time (Ti + Ts), the virtual carrier sense unit of said transmit-side STA sets the time (Ti + Ts) to the paired wireless channel as a new transmission inhibition time.

25. The wireless packet communication apparatus according to any one of claims 20 to 24, characterized in that

said transmit-side STA includes a unit which detects received power in the paired wireless channel caused by leakage from a transmitting wireless channel, and said virtual carrier sense unit sets the transmission inhibition time to a paired wireless channel having the received power greater than or equal to a predetermined threshold value.

26. The wireless packet communication apparatus according to any one of claims 20 to 25, characterized in that

said transmit-side STA includes a unit which detects an error in a received signal in the paired wireless channel, and said virtual carrier sense unit sets the transmission inhibition time to a paired wireless channel having an error detected.

27. The wireless packet communication apparatus according to any one of claims 20 to

26, characterized in that:

said transmit-side STA includes a unit which detects, when receiving a wireless packet over the paired wireless channel, an error in the received wireless packet;

when a wireless channel having normally received a wireless packet directed to an own STA has the set transmission inhibition time, said virtual carrier sense unit cancels the transmission inhibition time; and

when occupied time is set in a header of the received wireless packet, said virtual carrier sense unit sets a new transmission inhibition time in accordance with the occupied time.

28. The wireless packet communication apparatus according to any one of claims 20 to 27, characterized in that

when transmission data is generated, the virtual carrier sense unit of said transmit-side STA transmits a wireless packet using said wireless channel determined to be idle after waiting until the transmission inhibition time elapses when there is a wireless channel having the set transmission inhibition time.

29. The wireless packet communication apparatus according to any one of claims 20 to 27, characterized in that:

when transmission data is generated,

when the longest transmission inhibition time of the set transmission inhibition time of wireless channels is smaller than a predetermined threshold value, the virtual carrier sense unit of said transmit-side STA transmits a wireless packet using said wireless channel determined to be idle after waiting until the transmission inhibition time elapses; or

when the longest transmission inhibition time is greater than or equal to the predetermined threshold value, said virtual carrier sense unit transmits a wireless packet using said wireless channel determined to be idle without waiting until the transmission

inhibition time elapses.

30. The wireless packet communication apparatus according to any one of claims 20 to 27, characterized in that

when there is a wireless channel having the set transmission inhibition time at the time of transmission data generation, the virtual carrier sense unit of said transmit-side STA transmits a wireless packet using said wireless channel determined to be idle, without waiting with a predetermined probability until the transmission inhibition time elapses.

31. The wireless packet communication apparatus according to any one of claims 20 to 27, characterized in that

when transmission data is generated, the physical carrier sense unit and the virtual carrier sense unit of said transmit-side STA transmit a wireless packet using said wireless channel determined to be idle after waiting until all the wireless channels are determined to be idle.

32. The wireless packet communication apparatus according to any one of claims 20 to 27, characterized in that:

when transmission data is generated,

the physical carrier sense unit and the virtual carrier sense unit of said transmit-side STA transmit a wireless packet using said wireless channel determined to be idle after waiting until all the wireless channels are determined to be idle; or

when the longest transmission inhibition time of the set transmission inhibition time of the wireless channels is greater than or equal to a predetermined threshold value, the physical carrier sense unit and the virtual carrier sense unit transmit a wireless packet using said wireless channel determined to be idle without waiting until the transmission inhibition time elapses.

33. The wireless packet communication apparatus according to claim 29 or 32,

characterized in that:

when there are wireless channels having the set transmission inhibition time,

when there is a wireless channel having set transmission inhibition time smaller than a predetermined threshold value, the virtual carrier sense unit of said transmit-side STA transmits a wireless packet using said wireless channel determined to be idle after waiting until the transmission inhibition time elapses; or

when no wireless channel has set transmission inhibition time smaller than the predetermined threshold value, the virtual carrier sense unit of said transmit-side STA transmits a wireless packet using said wireless channel determined to be idle without waiting until the transmission inhibition time elapses.

34. The wireless packet communication apparatus according to claim 33, characterized in that

the virtual carrier sense unit of said transmit-side STA returns to determine whether there is a wireless channel having the set transmission inhibition time or whether all the wireless channels are idle, after waiting until the transmission inhibition time elapses when there are wireless channels having the set transmission inhibition time and there is a wireless channel having set transmission inhibition time smaller than a predetermined threshold value.

35. The wireless packet communication apparatus according to any one of claims 20 to 27, characterized in that

when transmission data is generated, the physical carrier sense unit and the virtual carrier sense unit of said transmit-side STA transmit a wireless packet using said wireless channel determined to be idle after waiting or without waiting with a predetermined probability until all the wireless channels are determined to be idle.

36. The wireless packet communication apparatus according to any one of claims 20 to

27, characterized in that:

said receive-side STA includes a unit which sets transmission inhibition time to a wireless channel receiving a wireless packet when the received wireless packet has the set transmission inhibition time, and which transmits an ACK packet to said transmit-side STA when a wireless packet directed to the own STA has been normally received, the ACK packet including the transmission inhibition time set in the paired wireless channel; and

said transmit-side STA includes a unit which updates the transmission inhibition time set for the paired wireless channel to transmission inhibition time of a paired wireless channel included in a corresponding ACK packet when receiving the ACK packet within a predetermined period of time after having transmitted said wireless packet.

37. A wireless packet communication apparatus comprising: one transceiver which multiplexes a plurality of sub-channels into one wireless channel for transmission and reception; a physical carrier sense unit which determines whether each of said sub-carriers is busy or idle from received power; and a virtual carrier sense unit which determines each of said sub-carriers to be busy during set transmission inhibition time, wherein said transceiver assigns, for simultaneous transmission and reception, a plurality of wireless packets respectively to a plurality of sub-channels determined to be idle by both said physical carrier sense unit and said virtual carrier sense unit, the apparatus characterized in that

said virtual carrier sense unit sets time (Tmax + Ts) as transmission inhibition time to sub-channels other than a sub-channel which requires longest transmission time Tmax among sub-channels used for simultaneous transmission and reception, the time (Tmax + Ts) obtained by adding a predetermined time Ts to the longest transmission time Tmax.

38. The wireless packet communication apparatus according to claim 37, characterized in that

when an existing set transmission inhibition time is smaller than the time (Tmax +

Ts), said virtual carrier sense unit sets the time (Tmax + Ts) to said sub-channel as a new transmission inhibition time.